Efficient CO2 and H2O Removal with Novel Adsorbents for Life Support Applications on Mars, Phase I

Completed Technology Project (2018 - 2019)

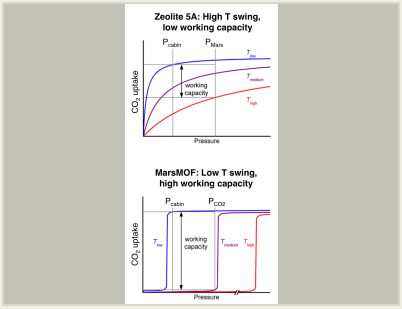
Project Introduction

Very low CO2 concentrations that accumulate quickly from human respiration can have dramatic health effects, and thus in NASA's history many technical removal strategies for CO_2 from a confined atmosphere have been suggested and explored. A CO2 removal system that functions in a is a new area of research, as the primary CO2 removal component in the state-of-the-art system doesn't have the adsorption performance behavior necessary to function in a Martian atmosphere. We propose to use an alternative adsorbent with unique and highly applicable CO2 adsorption properties - a diamine-appended metal-organic framework (MOF) - as a drop-in replacement for Zeolite 5A, the CO2 adsorbent onboard the ISS. Importantly, the mechanism for CO2 adsorption is disparate from the water adsorption mechanism, allowing the material to be the foundation of newly efficient CO2 removal processes.

Anticipated Benefits

Carbon dioxide (CO2) removal for breathing life support will always be a necessary component to human NASA missions. This proposal validates a new class of materials with remarkable CO2 removal properties at the low partial pressures relevant to human toxicity. Additionally, these materials are uniquely suited to perform in a Mars atmosphere. The chemistry of CO2 removal is more challenging on Mars than in a space vacuum, making the results applicable to any future Mars or non-Mars mission.

Industrial chemistry is a bedrock of modern society. Making chemicals, such as making the ethylene in polyethylene (grocery) bags, has two required components: making the chemical and separating it from any other molecules from the process. While this separation step could seem like an afterthought, in fact it is responsible for at least 10% of global industrial energy use! MarsMOF and the class of materials it belongs to have the potential to improve the cost of the world's largest separations.



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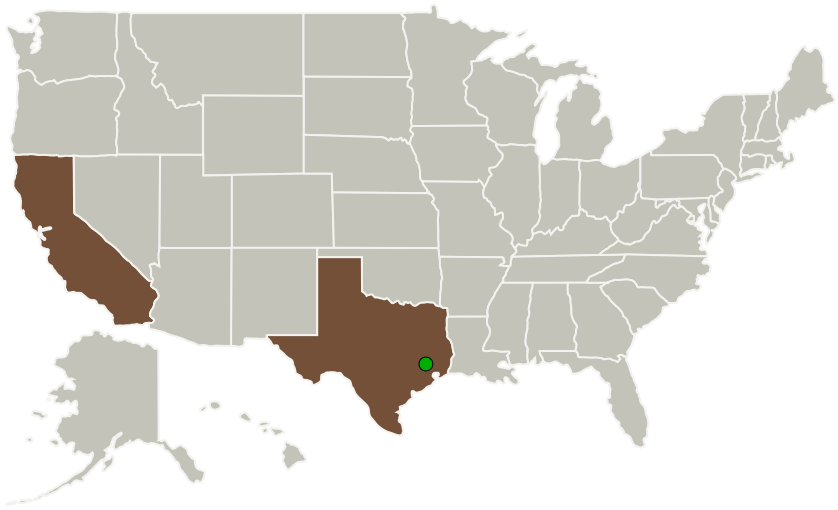
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Mosaic Materials, Inc.	Lead Organization	Industry	Berkeley, California
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas
University of California-Berkeley(Berkeley)	Supporting Organization	Academia	Berkeley, California

Primary U.S. Work Locations	
California	Texas

Project Transitions

July 2018: Project Start

August 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141331)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Mosaic Materials, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

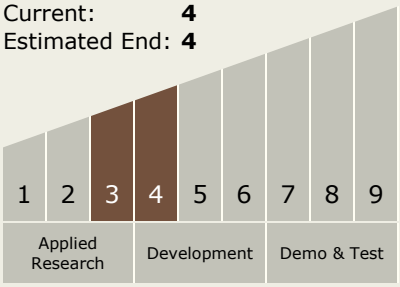
Carlos Torrez

Principal Investigator:

Thomas M Mcdonald

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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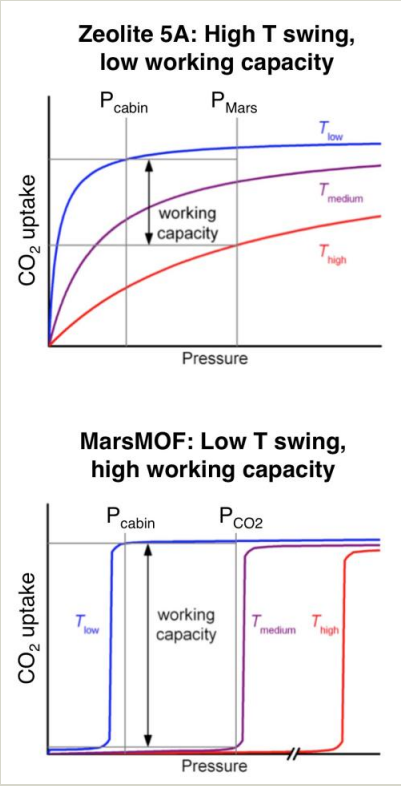
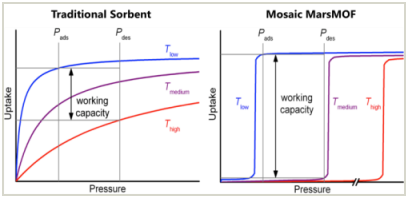
Images



Briefing Chart Image
Efficient CO2 and H2O Removal with Novel Adsorbents for Life Support Applications on Mars, Phase I
(https://techport.nasa.gov/image/128580)



Final Summary Chart Image
Efficient CO2 and H2O Removal with Novel Adsorbents for Life Support Applications on Mars, Phase I
(https://techport.nasa.gov/image/136309)

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.1 Environmental Control & Life Support Systems (ECLSS) and Habitation Systems
    - TX06.1.1 Atmosphere Revitalization

Target Destinations

Earth, Mars